

East Coast Climate Change Scenario Planning: Summary of Scoping Phase

December 2021



Context and Key Findings

In November 2020, several East Coast fishery management organizations¹ agreed to move forward with an East Coast Scenario Planning Initiative as a way to explore jurisdictional, governance and management issues related to climate change and fishery stock distributions.

Scenario planning is a tool that managers can use to test decisions or develop strategy in a context of uncontrollable and uncertain environmental, social, political, economic, or technical factors. The structure of a scenario planning process allows for the creation of multiple plausible futures (scenarios), and then a consideration of how best to adapt and respond to such circumstances. Scenario planning is not a tool for predicting future conditions - it's a method to be better prepared for a range of possible future conditions.

There are six phases scheduled in this East Coast Scenario Planning process:

Orientation (November 2020-July 2021)	This phase involves establishing the project objectives, structure, process and timeline. For this initiative, this phase included forming a core team, contracting a facilitator, familiarizing participating groups with scenario planning, and planning for the later stages of the process.
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¹ The fishery management entities involved in this initiative are the Atlantic States Marine Fisheries Commission (ASMFC), the New England Fishery Management Council (NEFMC), the Mid-Atlantic Fishery Management Council (MAFMC), the South Atlantic Fishery Management Council (SAFMC), and NOAA Fisheries.

<p>Scoping (July-December 2021)</p>	<p>The scoping phase is designed to inform a broader group of stakeholders about the initiative, and to gain stakeholder perspectives on the project as well as factors shaping east coast fisheries. Scoping input is intended to feed into later stages of the initiative. For this initiative, this phase included creation of scoping materials and website, three public scoping webinars, and an online questionnaire.</p>
<p>Exploration (January-March 2022)</p>	<p>The exploration phase includes identifying and more thoroughly exploring the major factors that are expected to drive change in the fisheries along the east coast over the next 20 years, including their current trends and uncertainties. As discussed in section 5, several webinars are planned for February-March 2022 to further investigate physical/climate, biological/ecological, and socioeconomic drivers of change.</p>
<p>Scenario Creation & Synthesis (April-June 2022):</p>	<p>The scenario creation phase will include a workshop with a limited number of stakeholder participants who will produce the scenario framework. Following the workshop, scenarios will be refined and narratives associated with each scenario will be developed.</p>
<p>Application (July-December 2022)</p>	<p>This key phase of the process will use scenarios to help discuss, brainstorm, test and revise governance and management approaches and develop tools and processes in response to uncertain future conditions identified in the scenario creation phase. Managers will be an important part of this process to develop recommendations for management and governance changes. This initiative will likely include multiple meetings and webinars with various participants.</p>
<p>Establish Scenario Monitoring (January-March 2023):</p>	<p>This phase will establish a mechanism for the ongoing monitoring of important indicators that may signal the emergence of one or more scenarios. Monitoring of scenarios is important to ensure flexible strategies that can change in line with future conditions. The ongoing monitoring process will continue in the months and years following this final phase.</p>

This document provides a summary of Phase 2, the scoping process, describing work undertaken between July and December 2021.



Purpose of Scoping

The scoping phase of this project had three purposes:

- i. To introduce and explain the initiative to a range of stakeholders, encouraging them to engage throughout the process.
- ii. To receive input about the draft project objectives, focus and expected outcomes that were articulated at the beginning of the initiative.
- iii. To invite ideas from a broad range of stakeholders about the factors and issues that might shape the future of East Coast fisheries, and hence should be included in the scenario analysis as the initiative continues.

Scoping Activities

The scoping phase involved three main activities:

1. **Creation of a set of materials and a redesign of the initiative website.** A 4-page brochure was created to introduce scenario planning and the specifics behind the initiative, along with a series of videos that explained the main elements of the work. This material was posted to a redesigned website. Details can be found at: [Mid-Atlantic Fishery Management Council – East Coast Climate Change Scenario Planning Initiative](#)
2. **Three 90-minute introductory scoping webinars** (each with the same content and format) were held on August 30, September 1, and September 2, 2021. The sessions began with a 30-minute presentation² to introduce scenario planning and the objectives and focus of the initiative. This was followed by a set of breakout group conversations where participants were able to share their existing experiences of climate change and their perspectives on how it has impacted east coast fisheries to date. Participants also had the chance to provide feedback on the project objectives, focal questions, and expected outcomes. For more information on the webinars, see Appendix 1.
3. **An online questionnaire** was designed and distributed to stakeholders. This was developed to capture feedback on project objectives, ideas about the factors and issues that might shape East Coast fisheries in the next 20 years, and any other advice or guidance that might be helpful for the planning team as the initiative moves forward. The online questionnaire was available for 32 days from August 30th through September 30th, 2021. For a copy of the questionnaire, see Appendix 2.

² A recording of this presentation (in four parts) is available on the initiative website at: <https://www.mafmc.org/climate-change-scenario-planning>.

Key Observations

The following are the key observations from this phase of the work. More details on each are provided in subsequent sections of this document.

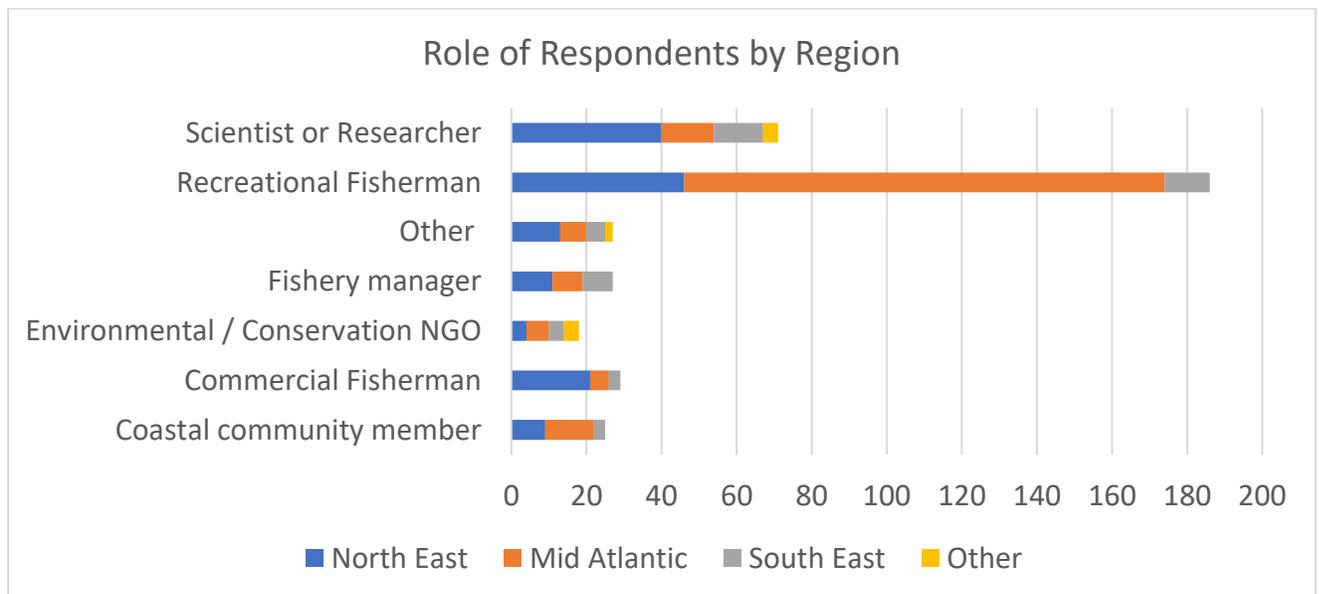
1. **High Levels of Interest in the Project:** There is a high level of interest in this initiative, and in the subject of how climate change might affect east coast fisheries in the future. Over 250 people attended the series of scoping webinars, and 383 people completed a questionnaire to provide their perspectives. Most people acknowledge that climate change will affect fisheries and are supportive of efforts that help all stakeholders prepare for the challenges and opportunities to come. Over 70% of questionnaire respondents (274 people) would like to continue to be informed and stay involved.
2. **Stakeholders Observations of Changing Ocean Conditions:** Stakeholders are already observing changing ocean conditions, habitat changes and changes in stock distribution and availability, mostly likely due to climate effects. They expect that these changes will continue - and possibly become more pronounced - in future years. Stakeholder observations raised during the webinars are summarized on pages 6-8.
3. **Feedback on Project Objectives:** There is general support for the objectives, focus and expected outcomes of this project. A large number of comments were received on the project objectives. Some comments recommended changes to the existing objectives, and others requested that additional objectives be included. Full details of the feedback, and the new wording of the revised project objectives can be found on pages 9-12.
4. **Feedback on Factors to Consider for Scenario Analysis:** Stakeholders identified a broad range of factors that might shape east coast fisheries in the next 20 years. These included climate-related factors, plus social, economic, political and technological factors. There were no discernible differences between stakeholder roles and regions in how respondents answered these questions. Each region/group, while having unique experiences, has a similar overall perspective when considering how climate change might shape the future of fisheries. Full details of the factors are provided on pages 13-14.
5. **Need to Balance Focus and Scope:** The next phases of the initiative must strike a balance between focus and scope. Participants see the importance of gathering and engaging wide-ranging input and perspectives in this process, while also recognizing the fact that this project is ultimately concerned with how fishery jurisdictional, governance and management issues will be affected by climate change. The next phases of this work (exploration, scenario creation and application) must be designed to balance the need for wide-ranging engagement and focused discussions. The overview of next steps in this process is summarized on pages 15-16.

1. High Levels of Interest in the Project

The response to the scoping period indicates a high level of interest in this subject from a variety of stakeholders along the coast. The introductory scoping webinars were attended by a total of over 250 stakeholders, while there were 383 responses to the online questionnaire. Recordings of the presentation given on the webinars, recorded in four parts, have been viewed between 75 and 145 times. Both the webinars and the questionnaire provided a wealth of information and ideas that will help shape the next phases of the work.

Webinar registration did not collect information to provide a specific breakdown of attendees by region and role, but the sessions involved wide-ranging conversations between commercial and recreational fishermen, fishery managers, scientists and other members of coastal communities. Detailed information was collected for the online questionnaire. Of the 383 responses, around half (186) were received from recreational fishermen, with a very large response (128) from the mid-Atlantic region. 71 responses were received from scientists/researchers, 29 from commercial fishermen, 27 from fishery managers and 27 from coastal community members. 18 participants from environmental/conservation NGOs also responded to the questionnaire. In terms of regional breakdown, 181 responses were from the mid-Atlantic region, 144 from the Northeast and 48 from the Southeast. The full questionnaire can be found in Appendix 2.

Figure 1: Number of online questionnaire respondents, by role and region. Other “roles” include: students, state government, environmental resource managers, commercial fishing organization representatives. Other “regions” include Canada, D.C., states away from the East Coast, and representative from groups of states.



2. Observations of Changing Ocean Conditions

During the scoping webinars, participants had the opportunity to discuss their personal perspectives and experiences with changing conditions that are currently impacting east coast fisheries. Participants are already seeing numerous effects that could be attributed to climate change, including: changes in species distribution; shifts in seasonal spawning; smaller size of fish; development of novel communities; water quality issues; water temperature changes; habitat distribution shifts; and human responses to changing conditions. Participants generally expect that these effects will continue - and possibly become more pronounced - in future years. Table 1 lists specific observations of changing conditions that are currently occurring, as raised by webinar participants.

It is notable that a large proportion of these observations of ongoing change are related to spatial and temporal changes in stock distribution. This reinforces that the intended focus of this initiative, management and governance responses to changes in stock distribution and availability, is an important and relevant issue for many stakeholders.

Table 1: Examples of changing conditions observed by scoping webinar participants.

<p>Physical, oceanographic, and coastal infrastructure changes</p>	<ul style="list-style-type: none"> ○ Rising ocean temperatures, evidenced by fishermen collecting data ○ Tides getting higher ○ Gulf Stream has changed ○ Coastal community flooding becoming a major issue ○ Salt water line creeping further inshore ○ Sea level rise impacting boat access infrastructure ○ Major storms impacting fishing infrastructure that does not get rebuilt (e.g., fish houses, ice houses, etc.)
<p>Human response to climate driven changes</p>	<ul style="list-style-type: none"> ○ Shoreline build up and hardening (e.g., due to development and sea level rise) causing problems ○ Realigning businesses to adjust to new species composition

Spatial and temporal species distribution changes

- Florida species (e.g., snook, tarpon, cobia, dolphin, king and Spanish mackerel) shifting distribution northward up the coast; spending less time in southern areas
- Georgia seeing more species previously found below Cape Canaveral
- Change in timing of when and how long species show up in an area, resulting in changing fishing seasons (e.g., spring and fall seasons getting shorter; traditional fall fisheries now start much later)
- Sheepshead now being directed on in NY
- Cobia now a directed fishery in Mid-Atlantic
- Charter captains from RI running wahoo trips
- Increase in smooth dogfish, chub mackerel, and sharks in RI
- Black sea bass moving north and east
- Formerly widespread croaker catches now limited spatially
- Flounder trawl fishery extended to the north
- Now seeing white marlin north of Provincetown, MA
- Lionfish range expansion
- Shifting distributions in the Chesapeake Bay (e.g., increase in cobia, red drum, penaeid shrimp; decrease in summer flounder)
- Blue crab fishery and oyster restoration impacted by ocean acidification
- Summer flounder moved offshore and into deeper water
- Increase in spotted sea trout in Mid-Atlantic
- Occurrence of more southern species in fishery surveys (e.g., pompano, lookdowns and mojarras)
- Surveys and monitoring programs needing to adapt to changing distributions, raising continuity issues

<p>Abundance and productivity changes</p>	<ul style="list-style-type: none"> ○ Fewer black sea bass in south Florida ○ Smaller size fish observed on several species ○ Indian river lagoon not productive anymore ○ Lower abundance of some species (e.g., lobster, winter flounder) ○ Spawning peaks are not at the same times they used to be ○ Scallops now spawning more than once a year ○ Collapse of American lobster in Long Island sound ○ Shift in clam resources in the Gulf of Maine (i.e., decrease in soft shell and increase in quahog)
<p>Water quality and habitat changes</p>	<ul style="list-style-type: none"> ○ Pollution issues leading to fewer fish inshore ○ Coral reef bleaching and disease ○ Freshwater under much of the Keys is shrinking; terrestrial habitats and mangroves are moving up-gradient ○ Estuaries, marshes, mangrove habitats disappearing or dying ○ Pollution causing die offs of lobster and other species ○ Horseshoe crabs nursery habitats are being lost ○ Eelgrass less common in the Chesapeake ○ Sea level rise impacting salt marshes ○ Loss of living shoreline having detrimental habitat effects ○ Negative impacts of beach renourishment
<p>Species interaction changes</p>	<ul style="list-style-type: none"> ○ Development of novel communities (e.g., black sea bass predation on juvenile crustaceans and fishes) ○ Changes in phytoplankton and zooplankton that affect the food chain ○ Seabirds suffering starvation due to temperature changes impacting forage base ○ Shift in forage base in Northwest Atlantic (e.g., low abundance of herring and mackerel, shift to other forage species such as sand lance)

3. Feedback on Project Objectives, Focus, and Outcomes

One of the most important parts of scoping was to gather reactions and responses to the project objectives, focus, and expected outcomes. Stakeholders provided feedback on these elements during the webinar breakout conversations and through the online questionnaire. A number of comments suggested adjustments to the objectives. A more detailed analysis of the comments received via the online questionnaire is contained in Appendix 3.

Taking account of all comments, the draft project objectives were discussed at the November meeting of the NRCC, and have been revised as follows (new text in red):

1. Explore how **East Coast** fishery governance and management issues will be affected by climate driven change in fisheries, particularly **changing** stock availability and distribution.
2. **Advance** a set of tools and processes that provide flexible and **robust** fishery management strategies, **which continue to promote fishery conservation and resilient fishing communities**, and address uncertainty in an era of climate change.

Commentary on Project Objectives Revisions

Objective 1: Explore how **East Coast fishery governance and management issues will be affected by climate driven change in fisheries, particularly **changing** stock availability and distribution.**

This objective was originally written to acknowledge the focus on exploring governance and management issues at a time of climate change. One suggested change was to specify that the initiative will focus on **East Coast** governance and management. Second, the wording has been modified so that “shifting” has changed to “**changing**” stock availability and distribution. This acknowledges the possibility that stocks might not only shift (in location), but also change, in terms of availability and distribution. Using “changing” allows us to create scenarios that encompass a broader range of future possibilities for east coast stocks.

There were several other comments related to Objective 1 that, ultimately, did not get reflected in a revision to the objective, but are still important to note. Many participants wanted to expand the scope of the objectives beyond a focus on the climate impacts of stock availability and distribution. They saw value in explicitly including reference to productivity and habitat changes, as well as other elements such as invasive species, spawning site health, migration impacts etc. Others felt that Objective 1 should specifically reference non-climate drivers of change. All of these factors are important to consider in any exploration of the future of fisheries. They will no doubt emerge as key elements in the scenario storylines in later phases of this process.

However, these suggestions were not included in the revised project objectives to ensure that the project focus remained on *governance and management issues relating to changing stock availability and distribution*. This initiative is not an exploration of how climate change affects habitat (for example) per se. It is an exploration of how climate change affects stock availability and distribution. If stock availability and distribution is affected, in turn, by habitat changes, then habitat changes should and will be highlighted and discussed within the scenarios. But the *focus* for this project remains on changing stock availability and distribution. Many saw the value of maintaining this focus: stakeholders noted that they appreciated that this project was not “trying to address everything.” For example, “what is causing productivity change is hard to tease out.”

Similarly, there were requests that some non-climate factors be included in the wording of this objective. One request suggested that the objective should explore the consequences of the development of aquaculture facilities. Even though this is a likely development over the next 20 years, this specific wording was not included in the project objectives, as it would have diverted from the desired focus. However, it is expected that non-climate factors will be an important part of the discussions and included in the scenario stories, especially if they affect changes in stock availability and distribution.

Objective 2: Advance a set of tools and processes that provide flexible and robust fishery management strategies, which continue to promote fishery conservation and resilient fishing communities, and address uncertainty in an era of climate change.

There are three slight changes to this objective. First, the term “develop” was changed to “**advance**” to reflect the fact that there are already many tools and processes in existence that management and other stakeholders could use in the governance and management of fisheries in the future. Not everything needs to be developed from scratch. As such, “advance” will guide us towards reviewing existing tools in addition to identifying new ones. Second, the requirement that fishery management strategies be “**robust**” was added in addition to “flexible” in order to better reflect uncertainty in the system. Third, some comments were received about the need to include language regarding **conservation and the support of fishing communities**. As a result, the revised objective specifies that any fishery management strategies should have the goals of promoting both fishery conservation and resilient fishing communities.

Other comments regarding the objectives revealed the difficult balance between breadth and specificity. Some people saw the objectives as too vague; they wanted to see more specificity in the goal and the tasks required to achieve it. Others felt that they were too specific, and hence restrictive. In these cases, respondents saw the value of cross-disciplinary collaboration in thinking creatively about managing stocks in a very different future. Overall, it was recognized that it was hard to see specifics at this stage. Fisheries management is very complex and reactive, and there are laws that constrain

what can be done. But one overall purpose of this initiative is to move fisheries management from a reactive to an anticipatory process.

Suggestions for Additional Objectives

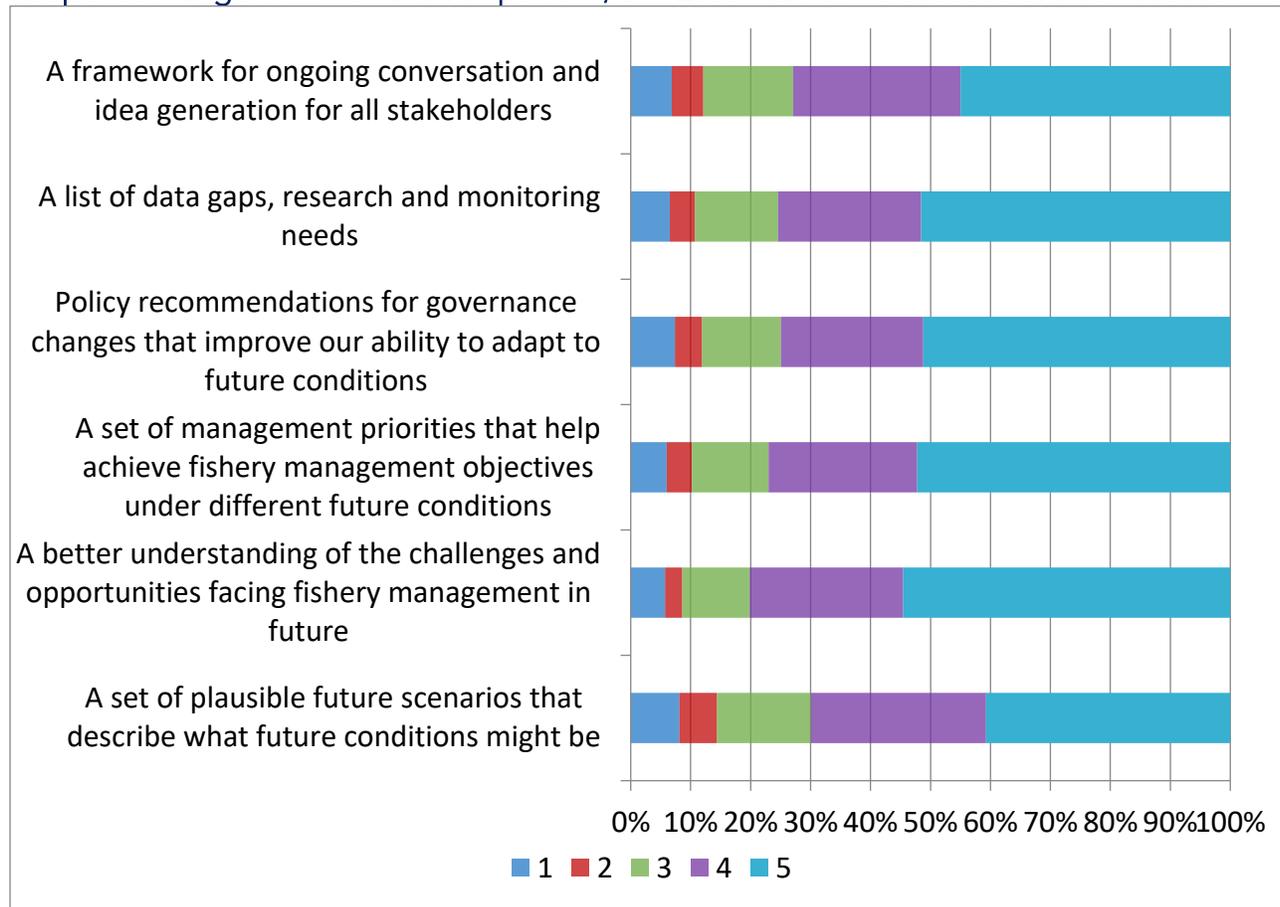
Several respondents made suggestions for additional project objectives. These included requests for the initiative to include goals related specifically to **improving fisheries science** - helping to improve the scientific infrastructure and data collection that informs fisheries management in light of climate change. Others saw the value in adding an objective related to the development of **ecosystem-based fisheries management** (EBFM) strategies. There were requests that this initiative also include a specific objective focused on **education of fisheries stakeholders and the public** at large, in anticipation of climate change implications for fisheries. Finally, some participants called for an objective that focused specifically on addressing **allocation issues**, including a re-evaluation of landings in regards to states' allocations.

While all of these are important issues that require consideration, it was decided that there are other venues and processes that are more directly suitable for those discussions. These issues will surely emerge during, or as an outcome of, the scenario process. Accordingly, we will plan to track any and all relevant recommendations that surface during the scenario planning initiative and forward them to staff working on other climate change-related efforts in the region.

Overall, the findings on objectives reinforced our belief that the current focus is appropriate for this scenario investigation. There will be many ways in which climate change will affect fisheries. Several of these will no doubt be touched on in the scenario work, but the focus of the scenarios will primarily be on describing how climate change might affect stock availability and distribution. These scenarios will then be used to explore the future implications for fishery management and governance across multiple jurisdictions.

Finally, respondents were asked for their view on a list of six expected project outcomes. Based on questionnaire responses, all the outcomes were deemed important or highly important. The highest ranked outcome was *"a better understanding of the challenges and opportunities facing fishery management in future."* This feedback suggests that no changes are needed to the list of draft expected outcomes.

Figure 2: Respondents' views on the importance of expected project outcomes.
 Response Range: 1 = Not at all important, 5 = Essential to the success of this initiative.



4. Feedback on Factors for Scenario Analysis

Several of the questions asked respondents for their views on the factors that are likely to shape East Coast fisheries over the next 20 years. This question was asked in many different forms: *What climate-related factors are predictable? What climate-related factors are important but unpredictable? What climate-related factors might be very surprising? And what other factors might shape fisheries?* The purpose of the multiple questions is to ensure that as many ideas as possible are captured, and also to provide a distinction between predictable and unpredictable aspects of the future. The responses to these questions then form the “building blocks” from which scenarios will be constructed. A full analysis of online questionnaire responses for these factors is contained in Appendix 4.

Responses were analyzed across regions and stakeholder roles. There were no discernible differences in how respondents answered these questions. Each region/group, while having unique experiences, has a similar overall perspective when considering how climate change might shape the future of fisheries.

There was broad agreement on climate-related factors that are *predictable and expected*. The top three were: (i) ocean temperature change; (ii) ocean acidification; and (iii) sea level rise. Other predictable factors raised by some groups were offshore wind, issues around water quality/pollution, shifting stocks and changes in fish and ecosystem structure.

Factors that are important *but unpredictable* included:

- **Biological uncertainties** (e.g., changing spatial distributions, health of stocks, habitat loss, rate of ecosystem change). As discussed earlier, the focus of these scenarios will be on changing stock availability and distribution, so it is notable that participants see this is an important and unpredictable factor. Our scenarios will focus on telling stories about various ways in which stock availability and distribution might change in the future. The scenario analysis will also pay attention to many other related factors in this category, e.g., changing habitat, ecosystems, stock health and productivity.
- **Physical uncertainties** (e.g., rate and magnitude of sea level rise, ocean temperature changes). Factors in this list mirrored many of the predictable factors (i.e., ocean temperature change, acidification and sea-level rise). The difference here is that the uncertainty is around the *rate and scale* of such changes. How high will ocean temperatures go in 20 years? How extensive or damaging will ocean acidification be? How quickly will the seas rise in 20 years?
- **Social and economic uncertainties** (e.g., competing ocean uses, impacts on fishing communities, consumer demand). These factors recognized the importance of potential new developments such as aquaculture and offshore

wind installations. There were also uncertainties raised that related to the impact of climate change on fishing communities, and how resilient they are.

In response to these questions, many respondents identified governance and management as key uncertainties. For example, *what will be the future effectiveness, adaptability and flexibility of fishery management approaches?* For the purposes of the scenario exercise, these “uncertainties” will be treated differently from the physical, biological and social/economic elements referenced above. Questions about governance and management are what this initiative *is aiming to address*. The scenarios - different stories about how climate change might affect stock availability and distribution - will be used as a platform to discuss possible governance and management approaches, and identify actions that will improve the effectiveness, adaptability and flexibility of future fishery management approaches.

We also asked about uncertainties in a different way, by asking participants to consider *wildcards* - What climate related events might have unexpected and highly disruptive impacts to East Coast fisheries? Responses here included severe storm events, changes in ocean currents, harmful algal blooms, pollution, and significant fishery loss.

Other, non-climate factors that have the potential to shape the future of East Coast fisheries included stakeholder cooperation, degree of public interest, population growth (accompanied by coastal development), and competition for ocean uses.

All these factors (certainties, uncertainties, and wildcards) and more will be considered in the next phases of this work. We will explore these factors in more detail, and they will provide the “building blocks” for our scenario creation.

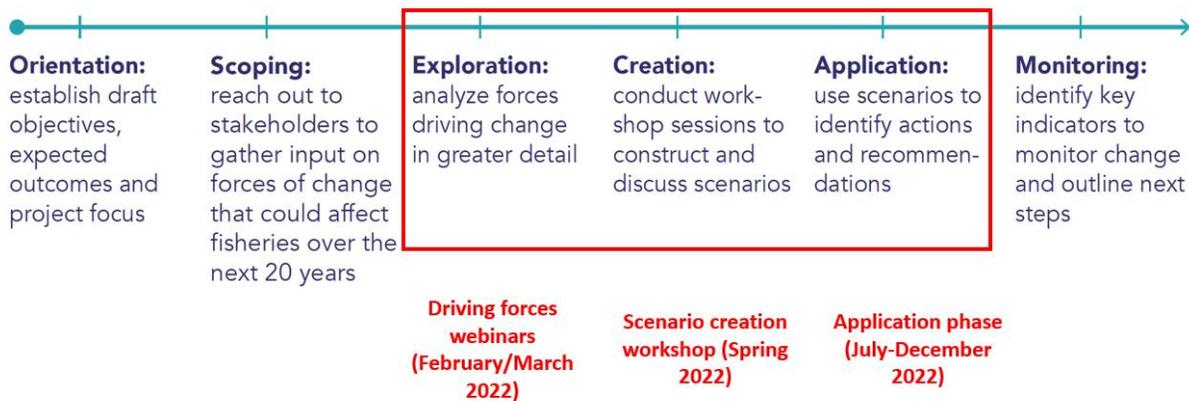


5. Next Phases of This Initiative

The scoping phase has illustrated the importance of striking a suitable balance between (i) wide-ranging stakeholder engagement and (ii) a focus on the issues to be addressed in this initiative. Participants in the scoping process generally agreed that it was important to hear from a wide range of perspectives in this process. There are many stakeholders with an interest in the future of east coast fisheries. It is important to gather views from commercial and recreational fishing communities, in addition to scientists, fishery managers, and other members of coastal communities. However, while a broad range of viewpoints is essential, it is also important to maintain a degree of focus on the specific project objectives identified earlier.

Most immediately, the **Exploration Phase**, will identify and analyze the most important factors driving change in the fisheries (i.e., trends and uncertainties). This will be done through online discussions with a wide range of stakeholders. Following that, the **Scenario Creation and Synthesis Phase** will use those factors to produce the scenario framework and develop associated narratives. This work will be undertaken by a specific group of invited stakeholders who represent a wide range of fishery interests. Later in 2022, the **Application Phase** will use the scenarios to hold a series of conversations with many different stakeholders, inviting their input on the implications of the scenarios, and ideas for how fisheries should prepare for changing stocks and an era of climate change. As such, the forthcoming phases will strike a balance between wide-ranging engagement and focused discussions. Figure 3 summarizes the six overall phases of this scenario planning initiative and the red box identifies the next steps.

Figure 3: Summary of the six phases of scenario planning, including next steps with estimated timeline for this initiative (in red box).



Exploration Phase: January-March 2022

The exploration phase will ensure that participants are informed about the key drivers of change, including what is known and unknown about current and future trends. The core team is planning a series of three online webinars, open to all interested participants. These will feature presentations and discussions on forces driving future change in the fisheries. These will focus on the categories of forces identified in Section 4 (i.e. the physical/climate, biological, and socioeconomic uncertainties).

During the exploration phase, it will be important to strike a balance between discussing the very broad scope of factors that might affect fisheries in the future, and the need to maintain a degree of focus around the issues that shape changing stock availability and distribution. In addition, it will be important to remind participants of the ultimate goal, which is to explore what such changes might mean for East Coast fisheries governance and management.

Scenario Creation and Synthesis Phase: April-June 2022

Following the exploration phase, the scenario creation and synthesis phase will identify the priority factors driving change and use these to construct a scenario framework. This work will be undertaken by an invited group of participants (ideally in an in-person workshop). The group will be designed to represent the wide range of stakeholder interests related to the future of East Coast fisheries. As guided by the project objectives and focus, the scenarios will describe 3-5 different pictures of changing stock availability and distribution. These pictures will also include descriptions of habitat changes, non-climate trends, and other elements that create a set of plausible, relevant, challenging, and memorable stories. These stories, in turn, will be used to explore the consequences for East Coast fisheries governance and management.

Looking Ahead: Application Phase: July - December 2022

Scenarios are a means to an end. The “end” is a set of ideas, including actionable pathways for how fishery governance and management might need to change in an era of climate change. The scenarios will provide a valuable and novel platform for these discussions. This is the main purpose of the Application Phase (scheduled for July - December 2022). It will involve a series of meetings and workshops with various stakeholders, including fishery managers and regulators. Meeting attendees will read the scenarios and identify the main challenges (and opportunities) for fishery governance and management in these possible future worlds. They will then be asked to identify ideas for how East Coast fishery governance and management will have to change to cope with such new possibilities.

The scoping phase has provided valuable input for designing these conversations and ensuring there is the correct balance between scope and focus.

APPENDIX 1: Details of Introductory Webinars

Three 90-minute East Coast Scenario Planning introductory webinars were held on August 30, September 1 and September 2, 2021. These webinars each covered the same content and were attended by a total of over 250 stakeholders, including commercial and recreational fishermen, scientists, fishery managers, representatives from environmental NGOs, and other interested stakeholders from coastal communities.

The webinars were structured as follows:

- An **introductory presentation**³ that covered 4 main items:
 - An overview of the initiative, and an explanation for why it is important to explore the impact of future climate change on fisheries
 - An introduction to scenario planning, providing an overview of the method, example outputs and the benefits of the process
 - More specific details of the proposed work, including a description of the draft project objectives, focal question, and project outcomes
 - A description of the phases and timeline of the process, and a description of the various ways in which stakeholders will be invited to participate throughout the project.
- A set of **'break-out' group conversations**, that allowed participants to discuss (in smaller groups) their views on the project. Break-out groups were asked to comment on the following:
 - Immediate reactions or questions following the introductory presentation
 - Provide their perspectives on climate change to date, including how climate change may already be affecting ocean and fishery conditions
 - Offer comments or suggestions on the draft project objectives, focal question and expected outcomes.
- A **final, plenary session** where each break-out group reported back on their conversations. Participants were invited to discuss any important or common themes that emerged. Finally, participants were informed of how they could stay engaged in the process, by completing a forthcoming online questionnaire, and by checking regularly on the initiative website.

The following provides some notable ideas and findings that emerged from the webinar questions and conversations. Many comments fell under three general themes: 1) clarification of what the initiative is about and is not about; 2) this topic and process will require all participants to be open minded; and finally 3) traditional approaches to

³ A recording of this presentation (in four parts) is available on the initiative website at: <https://www.mafmc.org/climate-change-scenario-planning>.

fisheries management and governance may not be as effective in an era of climate change. Overall, most participants were able to describe ways in which fishery conditions have changed in recent years as climate change affects oceans, coastlines and fisheries (see Section 2 of this report).

Clarification of what the initiative is about

- During the session, it was clarified that this scenario planning initiative is not mandated or required. Instead, it should be seen as an opportunity to explore whether and how governance and management can be made more effective in future when faced with the impacts of climate change.
- This scenario planning initiative is primarily a qualitative process, focused on the consequences for governance and management. It will not provide specific information on stock status or assessment, but there might be connections to existing modelling work that might inform the scenarios.
- Participants recognized that this is an initiative that can make important connections between the pace of environmental change, the availability of real-time science to inform management, and developing a suitably nimble, transparent and fair governance scheme to apply the science. There was a recognition that relying on historical data might become less important as climate change shifts stocks.
- It will be important to define what is meant by fisheries governance: assume that this includes the existing structure of fisheries management, and also what might be needed to align with other coastal management processes that have impacts on fish distribution and habitat.

Recognizing the need to be open-minded

- There were calls to be open-minded about future possibilities. Discussions should not always be one-way. We should discuss aspects of warming impacts we are currently going through but should also discuss the possibility of cooling impacts in other places, and whether fish might migrate in various directions.
- We need to be mindful that things could change in an unexpected way. We know that it isn't going to stay static.
- Remember that while climate is the focus, we must keep in mind other issues impacting fisheries, including socio-economic impacts (e.g., aging of the fleet)
- A 'set of tools and processes' should broaden our view. We always look at climate change as temperature, but we should recognize it as so much more (habitat deterioration, acidification, carbon load). It would be great to develop an index or model that takes all the impacts into account and tracks how bad things could get.

Recognizing that climate change will challenge our existing mindsets and current approaches

- Thinking about climate change will require us to have a mindset shift about overfishing and overfished resources. Diminishing resources could be caused by a number of things, with overfishing being just one. We might need to identify new terms to describe what's happening. We need to be able to separate out impact of fishing on stocks from the impacts of climate change.
- Councils seem to be moving towards more limited access. This reduces flexibility, preventing fishermen from being able to switch to fisheries becoming more possible in regional waters. Limited access is the opposite direction of moving in a more flexible management style.
- A number of likely developments - shoreline hardening, sedimentation, beach renourishment - are outside the realm of fisheries management. How do we bring in other aspects of coastal management that can impact the distribution of fisheries and habitats?

APPENDIX 2: Online Questionnaire

East Coast Climate Change Scenario Planning Questionnaire

Introduction

To help prepare fisheries for an era of climate change, MAMFC, NEFMC, ASMFC, SAFMC and NOAA Fisheries are coordinating on a collaborative scenario planning initiative.

For further information on this East Coast Climate Change Scenario Planning work, please visit: <https://www.mafmc.org/climate-change-scenario-planning>

The scoping phase of this work is designed to gather ideas to inform later stages of the initiative. Your responses to this questionnaire will be confidential, and will be used to help design workshops and create scenarios.

Scenario work is all about anticipating and preparing for the future. Most of these questions ask for your views on issues that might affect fisheries over the next 20 years. Please think broadly and expansively about what could shape the future, and do not limit yourself to only focusing on issues that seem relevant today.

You'll see that the questionnaire mostly asks for free-form answers: we want to hear your views and ideas in your own words.

Question 1.

Where are you based?

Connecticut
Delaware
Florida
Georgia
Maine
Maryland
Massachusetts
New Hampshire

New Jersey
New York
North Carolina
Pennsylvania
Rhode Island
South Carolina
Virginia
Other (please specify)

Question 2.

What is your primary role?

Commercial Fisherman
Recreational Fisherman
Fishery manager
Scientist or Researcher
Environmental / Conservation NGO

Shoreside support (e.g. tackle shop owner)
Coastal community member
Other (please specify)



Question 3.

The draft objectives of this initiative are to:

1. Explore how fishery governance and management issues will be affected by climate driven change in fisheries, particularly shifting stock availability and distribution.
2. Develop a set of tools and processes which provide flexible and resilient fisheries management strategies to address uncertainty in an era of climate change.

Please provide any comments on these draft objectives. (e.g. do you support them as written? are they too specific, or too vague? are there other objectives you would like to see?)

Question 4.

The following provides a list of draft expected outcomes from the initiative. On a scale of 1-5, please rate the importance of these outcomes.

1=this outcome is not at all important, 5=this outcome is essential to the success of this initiative

- A set of plausible future scenarios that describe what future conditions might be
- A better understanding of the challenges and opportunities facing fishery management in future
- A set of management priorities that help achieve fishery management objectives under different future conditions
- Policy recommendations for governance changes that improve our ability to adapt to future conditions
- A list of data gaps, research and monitoring needs
- A framework for ongoing conversation and idea generation for all stakeholders

Question 5

CERTAINTIES: What climate-related forces (e.g. ocean temperature change, sea-level rise, acidification, consumer demand etc.) are you **certain** will shape fisheries on the East Coast between now and 2040? Please identify 2-3 of the most important.

Question 6

UNCERTAINTIES: What are the 'unknowns' or '**big questions**' that you - or others - are asking about the future of climate change and East Coast fisheries? Please identify 2-3 of the most important.



Question 7

WILDCARDS: Identify 1-2 climate-change related events that might occur in the next 20 years that could be unexpected and highly disruptive to East Coast fisheries?

Question 8

OTHER FACTORS: Beyond climate change, what other relevant factors (e.g. drawn from social, technological, economic or political forces) might shape East Coast fisheries over the next 20 years? Identify 2-3 of the most important.

Question 9

ACTIONS TO TAKE: What are 2-3 of the most important actions that fishery participants and managers might have to take in response to climate change over the next 20 years?

Question 10.

Please provide any further comments or suggestions to help inform or scope this initiative.

Question 11

Would you be interested in participating in further webinars and workshops as part of this initiative?

Yes

No

Question 12

If you answered yes to Q11, please provide your name and an email address for us to keep you informed of additional webinars and workshops.



APPENDIX 3: Comments on Project Objectives, Focus, and Outcomes

All questionnaire responses on project objectives were qualitatively analyzed using a thematic coding approach, which allows for the examination of themes or patterns within the text data. All survey results were analyzed using NVivo, a qualitative data analysis computer software package that facilitates the organization and rigorous analysis of mixed-methods data.

For question 3, responses were coded into 6 different categories: 1.) Changes are needed to existing objectives (n=100), 2.) Support objectives overall with no changes needed (n=80), 3.) Additional objectives are needed (n=32), 4.) Things to note and consider with objectives or the scenario planning process (n=34), 5.) Other unrelated comments (n=19). 6.) Disapprove of objectives (n=7). Table 2 below outlines the frequency of comments within each category, including the frequency of subcategories within each major category, as well as quotes that represent each sub-category.

Sub-categories with one comment were excluded from the tables. It is important to note that for the majority of questions, individuals responded with multiple answers, thus these responses were coded to the relevant sub-categories for each question. Therefore, the total number of comments per category does not represent individual responses, but frequency of responses per category.

Table 2: Summary of questionnaire responses regarding project objectives, focus, and outcomes.

Category of Response and Frequency of Comments within Subcategory	Total Number of Comments per Category	Example quote
<p>1. Changes to existing objectives are needed</p> <ul style="list-style-type: none"> ● The objective are too vague (18) ● The objectives should include/mention specific goals and tools that are being envisioned (15) ● Expand scope of objectives beyond climate impacts on shifting stock distributions, such as: invasive species, declining fish populations, spawning site health, migration impacts (14) ● Habitat should be included in objectives (9) ● Objectives should mention non-climate drivers of change (9) ● The objectives must emphasize maintaining, conserving, and protecting fish populations (6) ● Clarify, define, or minimize jargon within objectives (terms "resilience," "governance," and "fishery management issues") (5) ● Include changes in productivity to objective #1 (4) ● The objectives are too specific (4) ● Add language to the objectives about supporting the fishing industry and fishing communities (4) ● Incorporate equity in objectives (3) ● Refer to governance in objective 2 (3) 	<p>100</p>	<p>Vague: "Somewhat vague"</p> <p>Specific goals and tools: "These are broad-based objectives that require both an overriding goal and the development of specific tasks for each of the objectives."</p> <p>Expand scope: "Explore biological implications of climate change, including potential changes in reproduction and biomass."</p> <p>Habitat: "Should add something that recognizes the importance of protecting/restoring coastal habitats vulnerable to climate change as a component of long-term fisheries management"</p> <p>Non-climate objectives: "There is a big concern about fisheries will be managed in conjunction with aquaculture and offshore energy development. This is outside the councils authority and other federal agencies coordinate on limited basis with NMFS."</p> <p>Maintaining, conserving, and protecting fish populations: "Objective #1 should not prioritize exploring "shifting stock distribution" over the "conservation of fishery resources" in the face of climate driven change. Both should be explicitly recognized in objective #1, or alternatively, add a new objective with this conservation focus, for a total of three objectives."</p> <p>Jargon: "Objectives are good but not worded in such a way as to be accessible/easily understood by a layperson."</p>

<ul style="list-style-type: none"> • Replace “flexible” with “adaptable” (3) 		<p>Productivity: “In addition to changes in stock distribution, changes in productivity should also be considered”</p> <p>Too specific: “I see them as too restrictive. We're learning more about the value of cross-disciplinary collaboration, and that includes managing cultured and wild harvest stocks with synergy. This seems to keep the focus a little too tight to provide the breadth of scope needed to rise to the challenge in a meaningful and lasting way.”</p> <p>Supporting fishing communities: “I would like to see language about supporting the fishing industry and fishing communities which are already feeling the effects of climate driven stock shifts.”</p> <p>Equity: “Both objectives would benefit from incorporating equity and fairness into their guiding principles and goals.”</p> <p>Governance in objective 2: “Why no reference to governance in Objective 2?”</p> <p>Replace flexible with adaptable: “Maybe adaptable instead of flexible, flexible sounds like we can bend the rules.... we don't want people bending the rules”</p>
<p>2. Support objectives overall with no changes needed</p>	<p>80</p>	<p>Support: “I think the proposed objectives address the issues that must be considered.”</p>

<p>3. Additional objectives are needed</p> <ul style="list-style-type: none"> ● Add an objective focused on science (10) ● Add an EBFM objective (3) ● Add an objective focused on education of public (2) ● Add an objective focused specifically on allocations (2) 	<p>32</p>	<p>Science objective: “It would be helpful if the Scenario Planning initiative kicked off with a third objective focused on fisheries science: to help improve the scientific infrastructure and data collection that informs fisheries management in light of climate change. This would support, among other things, the proposed outcome below to develop “a list of data gaps, research and monitoring needs.” Given that this will be a cross-council effort that also includes input from agency staff in the regions and headquarters, there seems to be a real opportunity to help direct additional science-focused activities within the agency, SSCs, and council advisory bodies and teams. The importance of this work to climate-ready fisheries, and sustainable fisheries management in general, cannot be overstated.”</p> <p>EBFM objective: “Identify ecosystem-based fisheries management (EBFM) strategies that NOAA Fisheries and the fishery management bodies can pursue to sustain resilient ecosystems characterized by biological diversity, functional diversity, food web complexity, and spatial connectivity. *Such strategies should include ensuring abundant prey for dependent predators and incorporating ecosystem science in stock assessments and harvest policies.”</p> <p>Education objective: “Advise and inform fisheries stakeholders and public at large of anticipated climate change implications for fisheries.”</p> <p>Allocation objective: “Reevaluation of historic landings in regards to southern states and northern states allocations”</p>
<p>4. Things to note and consider with objectives</p>	<p>34</p>	<p>How will objectives be measured “These are pretty solid</p>

<p>and/or the scenario planning process</p> <ul style="list-style-type: none"> • How will these objectives be measured and will there be a time frame associated with them? (7) • "Shifting" stock distributions: not all stocks are shifting, some are expanding (2) 		<p>objectives, but I recommend having a timeline associated with them so they can be more measurable"</p> <p>Shifting distributions: "I support them as written as long as shifting stock distribution includes range expansions, not just shifting of the center point."</p>
<p>5. Other comments</p> <ul style="list-style-type: none"> • Climate change isn't real (19) 	19	<p>Climate change isn't real: "Until there is concrete scientific research that actually confirms all this climate change hysteria, I'm not buying it."</p>
<p>6. Disapprove of Objectives (7)</p>	7	<p>"I do not support them as written. The climate is changing like it has always done. I think wildlife will change with it and we should let everything adjust and help if needed to survive."</p>

APPENDIX 4: Analysis of Factors for Scenario Analysis

Questionnaire question 5: What climate-related forces (e.g. ocean temperature change, sea-level rise, acidification, consumer demand etc.) are you certain will shape fisheries on the East Coast between now and 2040? Please identify 2-3 of the most important.

Table 3: Most important climate-related “certainties” identified by user groups, listed in order of frequency.

Coastal Community Member	Commercial Fishermen	Environmental/ Conservation NGOs	Fishery Managers	Other	Recreational Fishers	Scientists
1. Temp. change (64%)	1. Temp. change (30%)	1. Temp. change (72%)	1. Temp. change (88%)	1. Temp. change (75%)	1. Temp. change (63%)	1. Temp. change (77%)
2. Ocean acidification (24%)	2. Ocean acidification (19%)	2. Ocean acidification (33%)	2. Sea level rise (37%)	2. Ocean acidification (36%)	2. Consumer demand (19%)	2. Sea level rise (30%)
3. Consumer demand (24%)	3. Offshore wind (19%)	3. Shifting stocks & changing productivity (27%)	3. Ocean acidification (26%)	3. Changes in fish and ecosystem structure (33%)	3. Sea level rise (12%)	3. Shifting stocks (25)
4. Sea level rise (24%)	4. Water quality/ pollution (15%)	4. Sea level rise and storm surge (22%)		4. Sea Level Rise (30%)		4. Ocean acidification (17%)

Most frequent certainties across user groups: Temperature changes, ocean acidification, sea level rise

Certainties noted, but not as frequently: Consumer demand, changing fish distribution, habitat issues, water quality issues, ability to make a living fishing.

Questionnaire question 6: UNCERTAINTIES: What are the 'unknowns' or 'big questions' that you - or others - are asking about the future of climate change and East Coast fisheries? Please identify 2-3 of the most important.

Table 4: Top categories and subcategories of uncertainties identified by questionnaire respondents, with illustrative example quotes.

Category of uncertainty	Subcategories	Example quotes
Biological uncertainty (137)	Shifting spatial distributions of fish stocks (39) Health of fish stocks (29) Habitat loss/destruction (23) Rate and magnitude of ecosystem change (20) Acidification (6) Tipping points (6) Changes in productivity (5) Loss of species (4) Invasive species (4)	"How fast will the changes happen. Of the most important fisheries now, which ones will diminish and which ones will improve" "The migration of our fisheries Northwards towards cooler waters or marine species shifting northward following the warming water temperatures." "Loss of habitat, and changing fisheries to new species" "How quickly ecosystem changes will happen, what will be the magnitude, and will changes be linear or instead be nonlinear with tipping points/regime shifts"
Social uncertainty (40)	Concerns with competing ocean uses (aquaculture, wind) (13) Stakeholder and manager cooperation in addressing climate issues (10) Adaptation of fishing communities (8) Environmental justice/equity (6)	"How to get people to cooperate with each other and with regulators." "How to best partner with Offshore Wind" "How can we address distributional shifts/expansions/contractions of economically valuable species in a fair and equitable manner?" "What are the socio-economic and environmental implications of climate change on coastal communities and how do the demographic characteristics of those communities drive those factors?"

Physical uncertainty (58)	Sea level rise (how much, where, impacts) (21) Changes in ocean temperature, circulation, chemistry (15) Storm severity and intensity (7) Pollution (6)	“Will the infrastructure be updated to deal with higher sea levels, more severe weather and tides etc” “Changes in ocean circulation - particularly in Gulf of Maine physical and biological tipping points how arctic changes will effect NE Atlantic Ocean”
Economic uncertainty (29)	Impacts to fishing industry, coastal communities and economies (23) Consumer demand (3) Cost of climate efforts (2)	“Impact on local fisheries as an industry even as its in decline. Impact on nation's ability to feed itself without excessive reliance on imports from markets that will also suffer from climate change.”
Management uncertainty (28)	Effective management approaches for a changing climate (governance/jurisdiction issues) (15) Adaptability and flexibility of management: can management keep up with changing fisheries and ecosystems? (13)	“How emerging fisheries will be addressed proactively so that they develop in a manner that is ecologically and economically sustainable.” “How will we respond to changes in allocations (both between states and fishery sectors) to maintain equitability when our current process relies mostly on historical landings that don't include impacts of climate change?”
Scientific uncertainty (15)	Stock assessment and model accuracy (10) Data needs and gaps to inform management and understand changing distributions of fish stocks (5)	“Do we have the real-time data needed to manage fisheries in a much more nimble and rapid way in response to changing ecological, social and economic conditions?” “Data gaps impede our ability to accurately assess future outcomes to various scenarios.”

Questionnaire question 7: Wildcards: Identify 1-2 climate-change related events that might occur in the next 20 years that could be unexpected and highly disruptive to East Coast fisheries?

Table 5: Top categories and subcategories of “wildcards” identified by questionnaire respondents, with illustrative example quotes.

Category of wildcards	Subcategories	Example quotes
Physical wildcards (115)	Impacts of increased storm events and severe weather (77) Current changes (38) Pollution (19) Sea level rise (16) Increased water temperatures (15) Ocean acidifications (9)	“Changes to currents and storm frequency/intensity” “Super cold winters. Too much rain” “Catastrophic ocean and coastal storms, summer heat waves.” “Favored spawning areas disrupted by storms and pollution.”
Ecological wildcards (60)	Fishery loss (15) Distribution and abundance (14) Loss of habitat (12) Disease (7) Invasive species (7)	“stock crash of keystone taxa group such as forage fishes due to largescale event such as a HAB” “Destruction of wetlands from extreme weather events” “Potential elimination of species due to climate driven loss of habitat and sea - temperature change”

Social wildcards (23)	<p>Conflict with offshore wind (11)</p> <p>Impacts to fishing and coastal communities (5)</p> <p>Changing market demand (5)</p>	<p>"people leaving fishing communities"</p> <p>"storms affecting society can have a trickle down effect on the fishing community and economy."</p> <p>"Development of offshore wind farms"</p>
Management wildcards (10)	<p>Management constraining fisheries access (5)</p> <p>Poor planning (2)</p> <p>Management not adapting to changing climate (3)</p>	<p>"A 30x30 initiative of marine sanctuaries up and down the coast that would mean even more area lost to fishing."</p> <p>"Fisheries management "Knee Jerk - Over regulation" due to political pressure and propaganda verses science based decisions"</p>
Other wildcards (6)	<p>Speed of change (6)</p>	<p>"Faster outcomes than expected"</p> <p>"Climate becomes much warmer than anticipated."</p>

Questionnaire question 8: OTHER FACTORS: Beyond climate change, what other relevant factors (e.g. drawn from social, technological, economic or political forces) might shape East Coast fisheries over the next 20 years? Identify 2-3 of the most important.

Table 6: Top categories and subcategories of “other factors” identified by questionnaire respondents, with illustrative example quotes.

Category of Other Factors	Subcategories	Example quotes
Social factors (88)	Lack of cooperation between stakeholders and managers (16) Public interest, concern, awareness of climate and fisheries issues/challenges (13) Political will to protect fisheries (15) Increasing population of humans/ increasing coastal populations (12) Equitable access to fisheries (9) Recreational and commercial competition (8)	“political infighting is causing a significant disruption in mankind's response to climate change. We have to find better ways to bring both political side to the table such they both see the benefits above the detractions.” “Equitable access to fisheries” “Political pressures, including Council makeup” “High-level political will to actually identify and implement solutions, or political will to do nothing.”
Physical factors (74)	Competing interests with windfarms/energy and aquaculture (36) Loss of working waterfronts and fishing communities (25) Pollution (8) Technological advancements (both positive and negative) (5)	“The major forces will be offshore wind and offshore aquaculture which bot pose existential threats to small boat fishing communities that lose their traditional grounds” “Offshore ocean uses that could compete or threaten wild fisheries if not planned carefully and with robust, science-based standards (aquaculture, energy)” “changes to the commercial fleet such as a lack of new entrants” “Increased fishing pressure recreationally”

Economic factors (66)	Changes in consumer demand (19) Coastal Development (18) Economic/political corruption (10) Fuel prices (5) Imports/international competition (3) Consolidation and corporatization of fisheries (3)	“Pressure of water based development by increasing retiree and edge city pressures” “State government being influenced by corporate money.” “Fisheries being managed by economics instead of what’s best for the fisheries” “Change in consumer demand and new consumer purchasing pathways” “Potential economic downturn affecting marketability of fish”
Management factors (48)	Increasing restrictions and regulations (10) Changing allocations (6) Loosening/weakening regulations(6) Not considering science in management (5) MPAs and area closures (5) Management not considering fishers (3)	“Continued impact of recreational discard mortality on fisheries already significantly regulated.” “Increased "No Fish" zones” “Commercial harvest is dependent on profitability. Reduced daily harvest and annual quota limits combined with operating expenses is already affecting commercial harvest economically.” “poor management as a result of changing politics rather than sound science”

<p>Ecological factors (34)</p>	<p>Overfishing (15) Changing species compositions and distributions Habitat loss (5) Increased interactions with endangered species and fisheries (5) Water quality issues (3) Increasing invasive species (3)</p>	<p>“Continued overfishing and failure to rebuild overfished stocks. Across the Atlantic coast, a number of fish stocks have struggled to recover, and several stocks remain subject to unsustainable fishing rates. New England continues to have the greatest challenges in this arena, with 15 stocks still overfished and 4 stocks subject to overfishing. Now is a critical time to act to secure the future of these fisheries and help them withstand climate change.” “Loss of habitat due to a synergy of anthropogenic impacts” “interactions with right whales”</p>
<p>Other factors (2)</p>	<p>COVID & other diseases impacting humans (2)</p>	<p>“Diseases that threaten mankind.”</p>

APPENDIX 5: Response to Other Questions

The final questions in the online questionnaire asked respondents for some additional information. One question inquired about the actions that fishery participants should take to prepare for the future. Another invited any comments or suggestions to help inform or scope the initiative. Finally, we asked respondents to indicate if they wished to be kept informed of the progress of this initiative. Results for each question are shown below.

Questionnaire question 9: ACTIONS TO TAKE: What are 2-3 of the most important actions that fishery participants and managers might have to take in response to climate change over the next 20 years?

Table 7: Top categories and subcategories of “actions to take” identified by questionnaire respondents, with illustrative example quotes.

Category of Actions	Subcategories	Example quotes
Management Actions (135)	Adaptive, flexible management (22) Reallocation of quota/quota assessments (16) Proactive management approaches (10) Protecting equitable access to fisheries (9) Restrict fisheries access (7) Greater cooperation between Councils/develop frameworks for cross-regional collaboration related to shifting stocks (7) Reduce effort/quota (6) Moratoriums on overfished species (6) Ease management restrictions (6) Permit flexibility (6)	“Diversifying the mix of species that each fisherman has access to through flexible or multi-species permitting allowing for aggregate quotas by functional guild as contemplated in the NEFMC’s EBFM example fishery ecosystem plan for Georges Bank” “Develop comprehensive management coverage for straddling stocks, as well as a framework for cross-regional cooperation and the handing off of authority as stocks shift range across management boundaries” “Rethink quota management” “Consider aquaculture as a way to replace wild harvest for existing participants” “increased harvester involvement in the management process” “Consider long-term (15-20 years) tradeoffs and accept the need for more adaptive management framework at the

	<p>Improve compliance/monitoring (6)</p> <p>Stronger management measures that conserve fisheries (5)</p> <p>Incorporate stakeholders in decision-making (5)</p> <p>Implement EBFM (5)</p> <p>Use of climate-based management measures, such as management triggers based on ocean temperatures and early warning indicators (3)</p> <p>Consider/expand aquaculture (3)</p>	<p>expense of personal gain"</p> <p>"Closed seasons and spatial management to avoid overfishing vulnerable stocks"</p> <p>"Predicting future distributions and estimating uncertainty of stocks"</p> <p>"reallocate fishing quotas"</p> <p>" Ensuring that management is adaptable but also maintains a sustainable and precautionary approach."</p>
<p>Biological Actions (26)</p>	<p>Better modeling and real-time monitoring being integrated into management (17)</p> <p>Protecting habitat (7)</p> <p>Limit pollution (2)</p>	<p>"Convert cutting edge science and monitoring more quickly into NOAA and state fisheries management process (including ASMFC; MAFMC and NEFMC)"</p> <p>"Advance monitoring efforts of climate-driven impacts on species, habitat, and fishing communities."</p>
<p>Social Actions (24)</p>	<p>Better communication, collaboration, cooperation, and education between different stakeholders (21)</p>	<p>"Education of the public to the problems at hand is key."</p> <p>"Cooperation and collaboration between interest groups, esp. between scientists and fishermen."</p>
<p>Economic Actions (14)</p>	<p>Reduce the carbon footprint of fisheries (8)</p> <p>Increase funding for research focused on climate change impacts to fisheries, especially cooperative research (2)</p>	<p>"Decarbonizing fishing fleets"</p> <p>"switch from gasoline powered craft to alternative energy motors focus on localizing supply of harvested fish (reduce large distance transport of fish for market)"</p>

Questionnaire question 10. Please provide any further comments or suggestions to help inform or scope this initiative.

Table 8: Top categories and subcategories of "other comments" from questionnaire respondents, with illustrative example quotes.

Category of Additional Comments	Subcategories	Example quotes
<p>Considerations in this initiative (75)</p>	<p>Include and actively engage fishermen, fishing communities, and have broad participation in the scenario planning process (20)</p> <p>Science needs and considerations (12)</p> <p>Management needs and considerations: need for flexible management (10)</p> <p>Resources/people to collaborate with: New England Fishery Management Council EBFM Committee, UMaine Lobster institute, SCDNR, NEFSC Cooperative Research Branch, rec fishers (7)</p> <p>Protect habitats (7)</p> <p>Language in survey is not accessible (2)</p>	<p>"Please make sure to include the perspectives and needs of coastal fishing communities, economies, and cultures"</p> <p>"need to develop more flexible management strategies in the face of climate driven shifting species distribution and productivity"</p> <p>"In general, I feel like this survey isn't geared towards a layperson - e.g. "Policy recommendations for governance changes.." - this kind of thing just comes across as government-speak"</p> <p>"Besides fisheries distribution, this initiative should also explore potential habitat changes (i.e., loss of wetlands and seagrass meadows as an example), and potential biological changes to spawning, reproduction and predator-prey relationships"</p>
<p>Kudos to the core team (21)</p>	<p>This is an important effort/thank you (21)</p>	<p>"Keep it up! This is an important conversation."</p> <p>"I think the Core Team working on this initiative is doing a phenomenal job. The conceptual nature of the project and the magnitude of its scope make this an especially challenging undertaking."</p>

Questionnaire questions 11 and 12: Would you be interested in participating in further webinars and workshops as part of this initiative? If you answered yes to Q11, please provide your name and an email address for us to keep you informed of additional webinars and workshops

- 71.5% responded "yes" to being interested in further webinars (274 individuals).
- 253 individuals provided their emails.